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$$\therefore y = -\frac{61a^4b}{360EI} = \text{deflection required.}$$

For cantilever beam, length  $2a$ , with the same load,

$$EI \frac{d^2y}{dx^2} = -A(x-z) = -\frac{2bx^3}{3a} + \frac{bx^4}{4a^2},$$

$$EI \frac{dy}{dx} = -\frac{bx^4}{6a} + \frac{bx^5}{20a^2} + C; \text{ when } x=2a, dy/dx=0, C=\frac{1}{5}a^3b.$$

$$\therefore EI \frac{dy}{dx} = -\frac{bx^4}{6a} + \frac{bx^5}{20a^2} + \frac{1}{5}a^3b.$$

$$EIy = -\frac{bx^5}{30a} + \frac{bx^6}{120a^2} + \frac{1}{5}a^3bx = \frac{2}{5}a^4b, \text{ when } x=2a.$$

$$\therefore y = \frac{24a^4b}{15EI} = \text{deflection at end of beam.}$$

Also solved by Harold Rowe.

**242. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.**

In a certain New York theatre there is an asbestos curtain supported by thin circular rings, radius  $r$ , which move on a cylindrical rod of radius  $a$ . The curtain is intended to be drawn by a *steady pull*. Taking  $\mu$  as the coefficient of friction, show that this will not be possible if  $r$  be less than  $a\sqrt{1+\mu^2}$ .

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

Let  $P$  be the resultant pull on a ring,  $\theta$  the angle between the direction of  $P$  and the normal to the surface of contact of ring and rod.

Then  $P\cos\theta$ =resolved part of  $P$  along the normal, and  $P\sin\theta$ =resolved part at right angles to the normal. For equilibrium,  $P\sin\theta < \mu P\cos\theta$ .

$$\therefore \sin^2\theta < \mu^2 \cos^2\theta, \text{ or } \cos^2\theta > \frac{1}{1+\mu^2}.$$

The diameter of the ring is in the direction of  $P$ ; diameter of rod is the normal.

$$\therefore \cos\theta = \frac{a}{r}. \quad \therefore \frac{a^2}{r^2} > \frac{1}{1+\mu^2} \text{ or } r < a\sqrt{1+\mu^2}.$$

**243. Proposed by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.**

A weight  $W$  is supported by three strings of the same size and quality lying in the same plane. The middle string is vertical, one string makes with it an angle  $\theta$  on one side, and the other string makes with it an angle  $\phi$  on the other side. Find the stresses  $T_1$ ,  $T_2$ ,  $T_3$  in the strings.